

Smart Table

Ahmad Ilaiwi
Wadee Abu Zant

Supervisor
Dr.Samer Arandi

Idea

Smart table is matrix of LEDs offering users utilities that make tables more than a piece of furniture.

Aims to

- entertain its users
- present different types of information in a new and an easy way
- making our world more interactive.

Tools

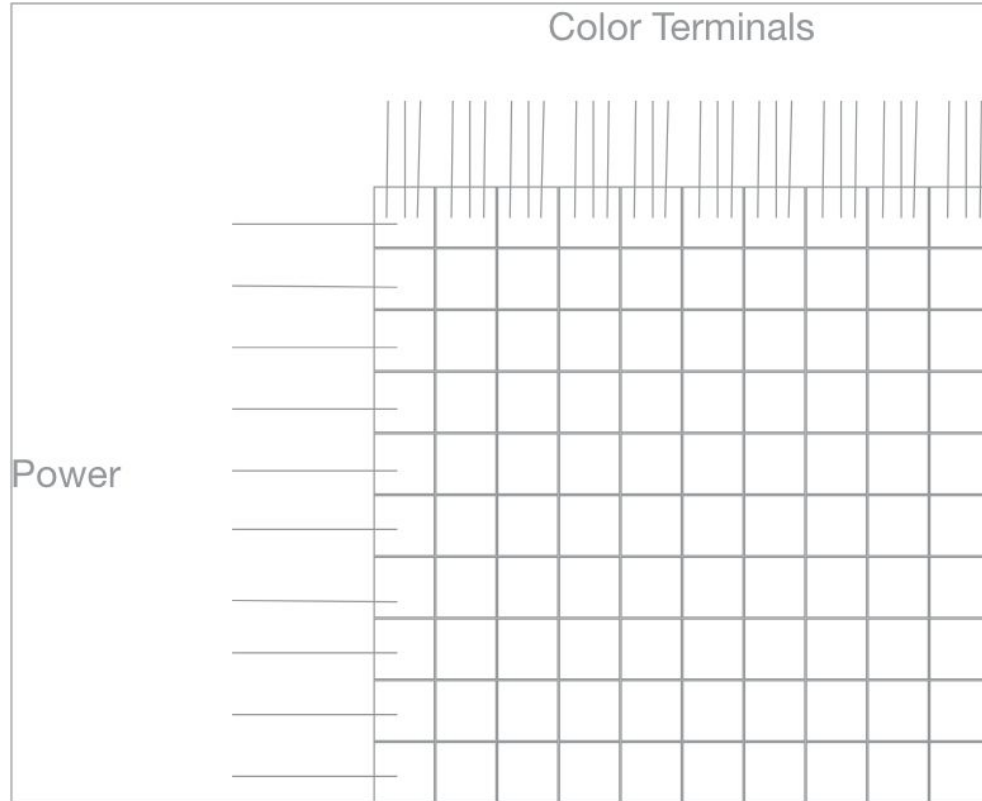
Logic

- Arduino Uno
- 100 RGB LEDs SMD 5050
- 595 shift registers (5)
- ULN2003 Darlington Array (5)
- Amplifier (4)
- Ultrasonic
- Bluetooth
- 7805 Regulator
- Wire Wrapper
- Wire Wrapping board

Hardware

- Wood
- Glue
- Butter Paper
- Hot Glue
- Wires
- Glass

Rows Switching



Design Stages

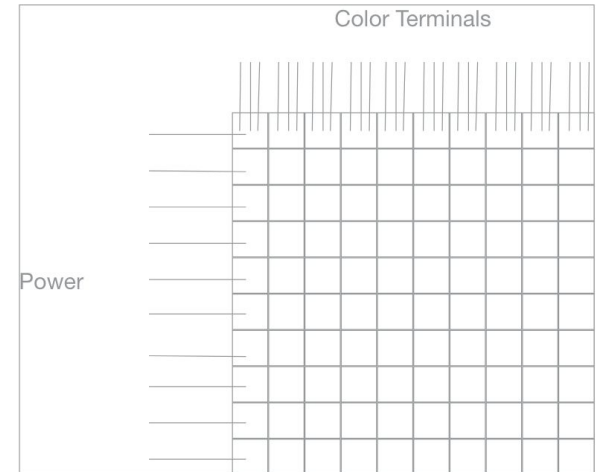
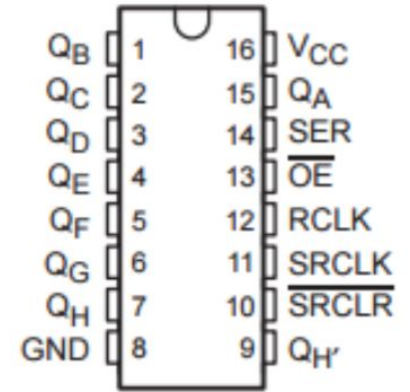
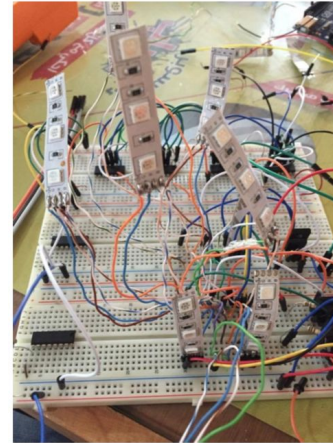
Early Stage

Object : control RGB LEDs using Microcontroller

Problem: 40 pins needed

Solution: Using BAM + 5 Shift Registers (SPI)

Result: 3 bins needed

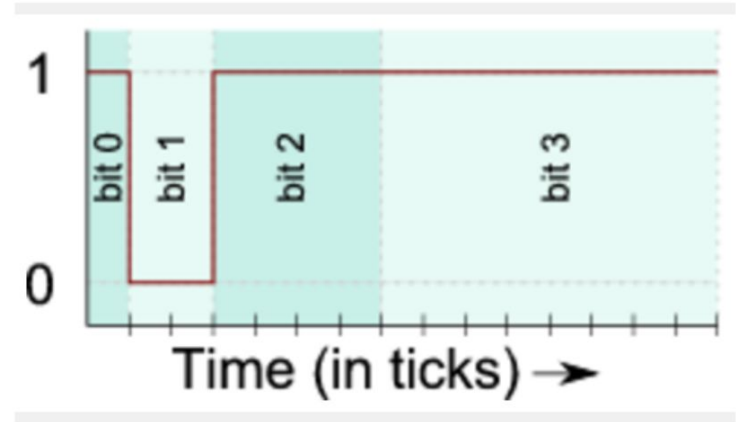


Bit Angular Modulation

BAM is another way to achieve voltage modulation.

Bit Angle Modulation makes use of a key property of binary numbers.

If we have a 4-bit code, the least significant bit represents "1", the next bit "2", the next bit "4" and finally the top bit has a weight of "8"



13/15th duty cycle

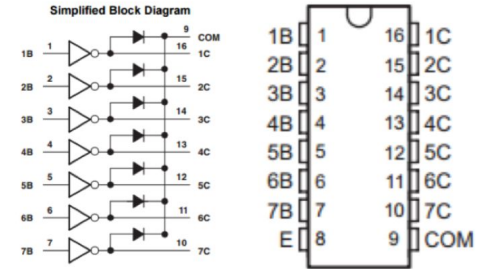
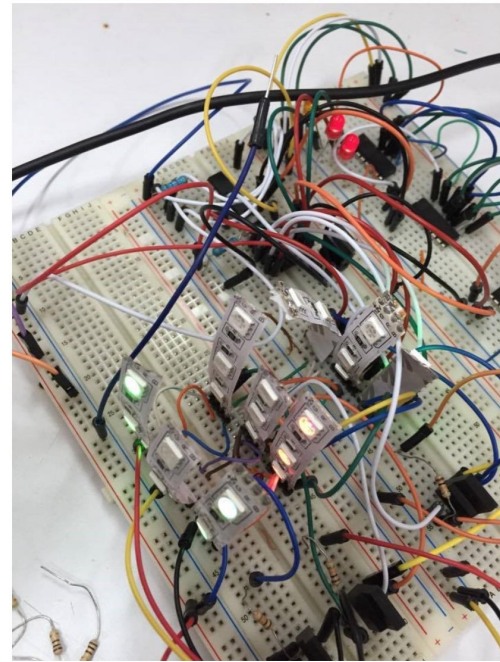
Second Stage

Object: Drive 30 RGB terminals with current

Problem: 30 terminal need 30 MOSFET which will cost 90 Shekels

Solution: Voltage controlled current source using 5 ULN2003 Darlington pair.

Result: Costed 30 shekels



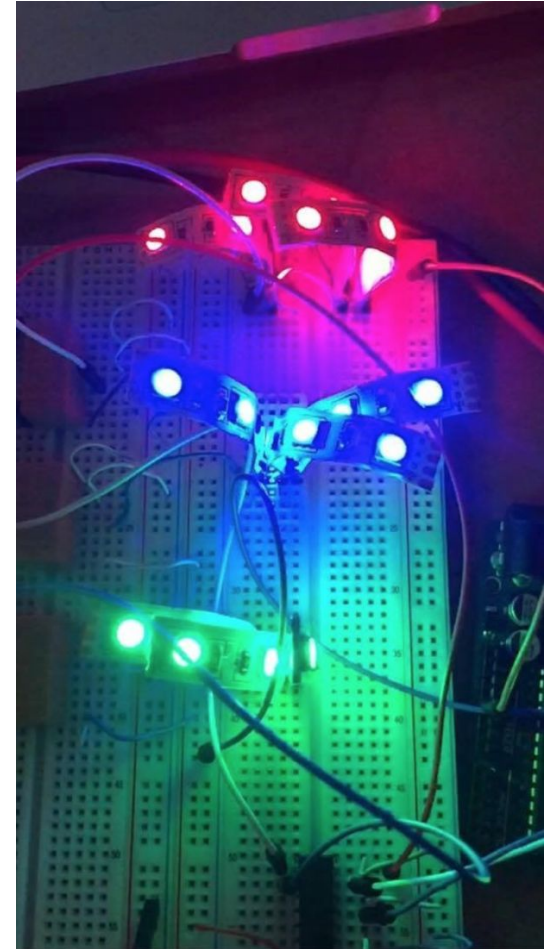
Third Stage

Object: Switching power between 10 Rows

Problem: Make sure the full power with 12V and 0.6 Amp is supplied to each row

Solution 1: Use Mechanical Switches

Problem 1: High noise



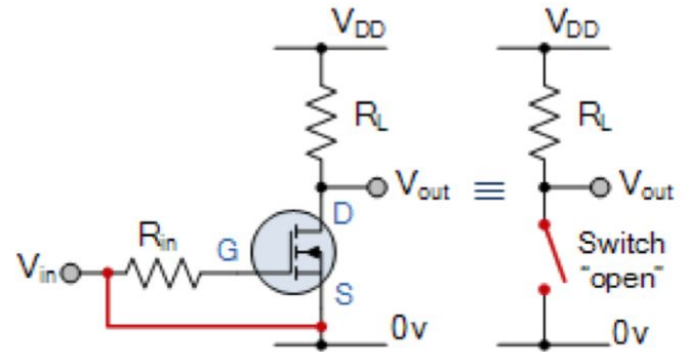
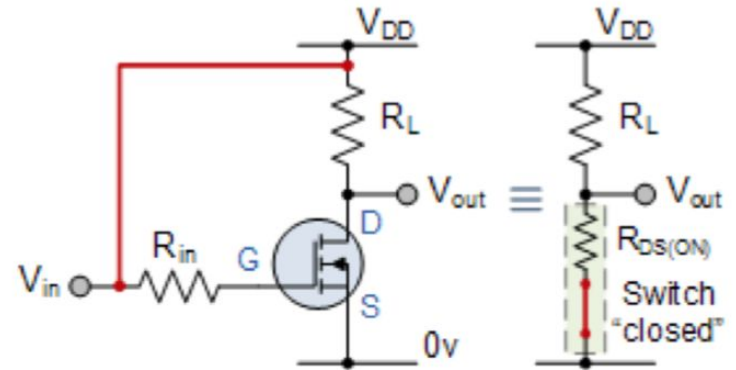
Third Stage

Solution 2: Use Digital Switches

Problem 2: High Price

Solution 3: MOSFET as a switch

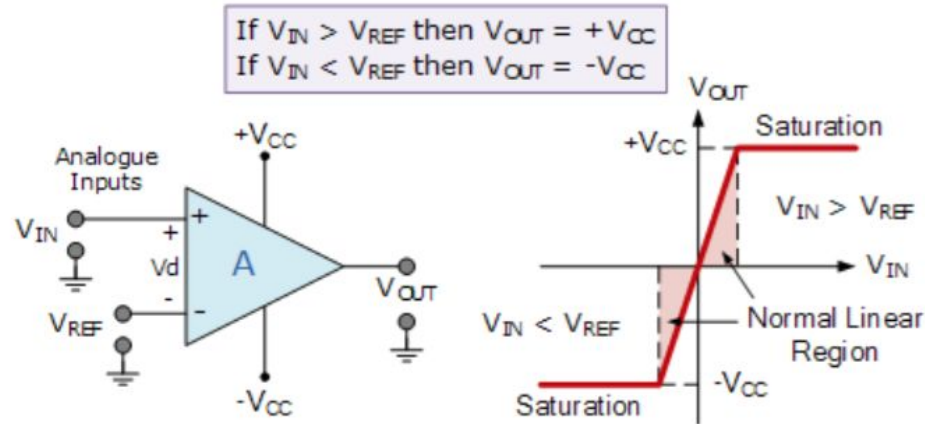
Problem 3: couldn't achieve full power



Third Stage

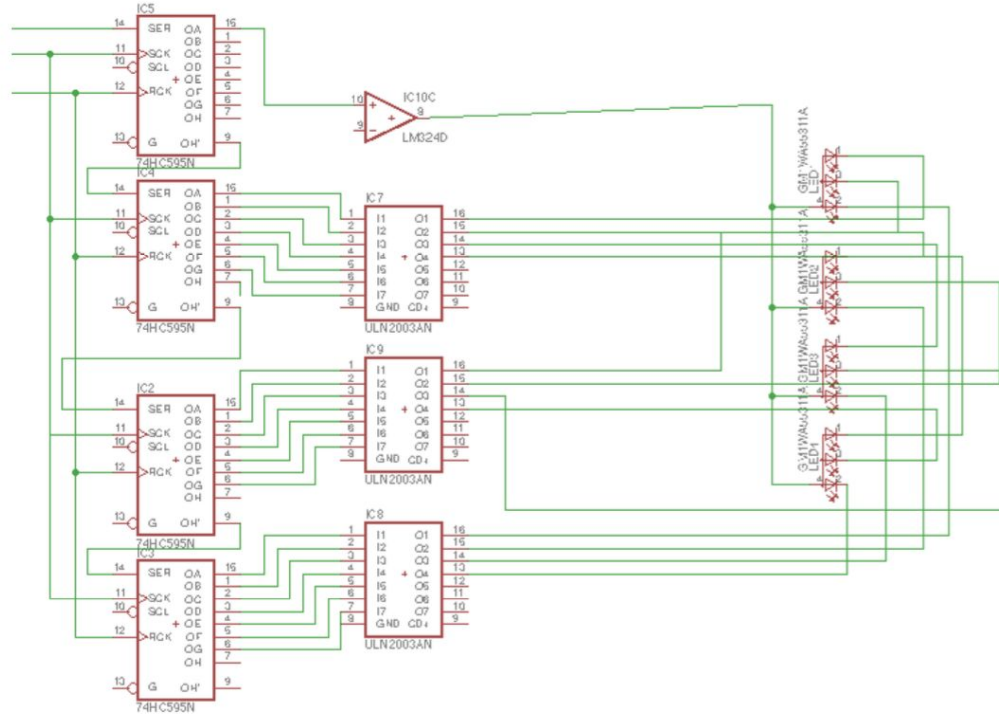
Solution 4: Use Amplifier as a switch

Result: Full cheap switches



Final Design

Driving LEDs

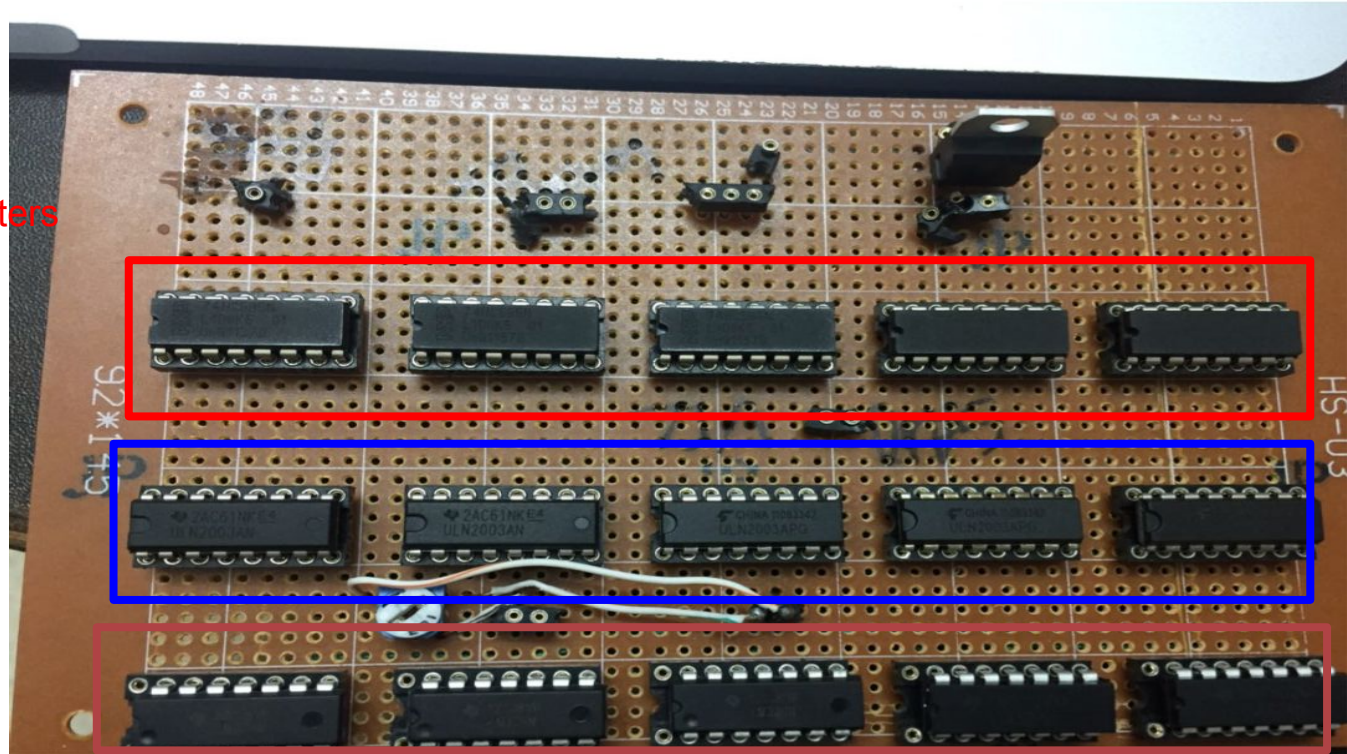


Driving LEDs

Shift registers

Darlington

Amplifiers



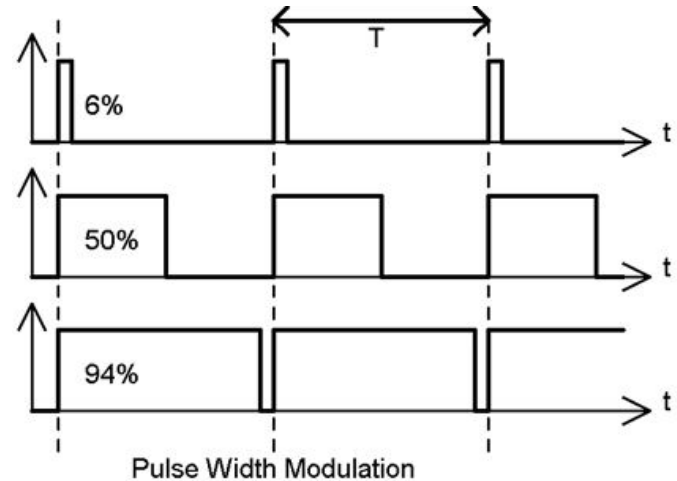
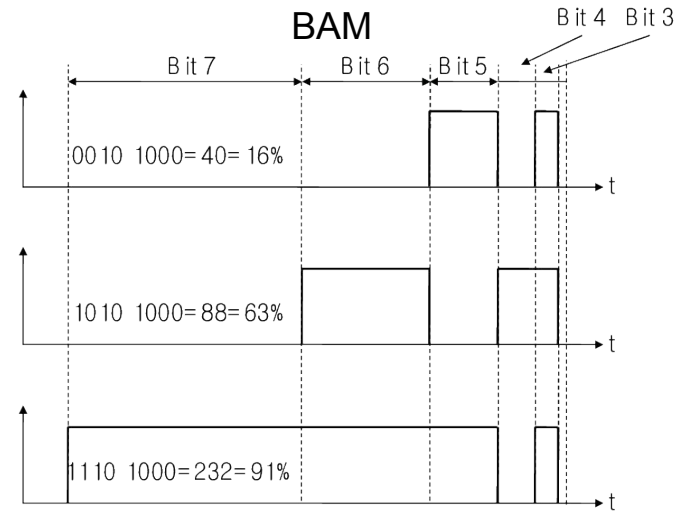
BAM VS PWM

PWM

- We need 30 Hardware PWM
- Software PWM is hard to maintain
- Require delays.

BAM

- BAM uses fixed timed interrupts
- Easy to control



Cycles

Interrupt clock at 8 kHz as in each 64 us an interrupt

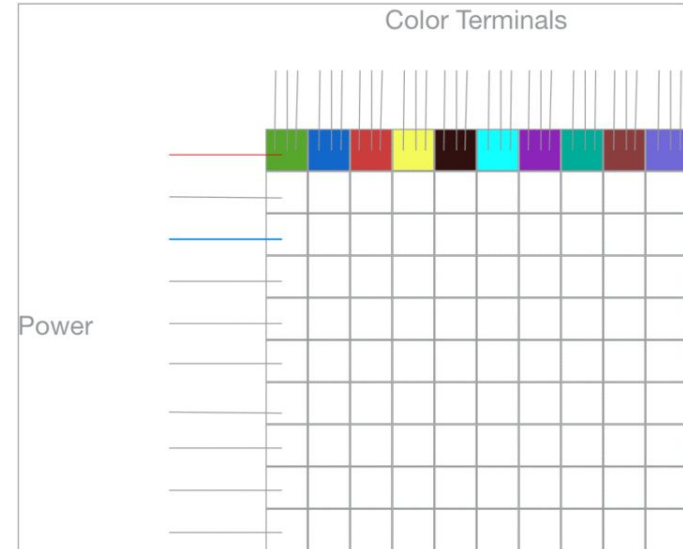
Using 4-bit BAM resolution we need we need 15 cycles to show color on the LEDs

We show color twice to get better average.

30 Cycle need 1.92ms ($64 \text{ us} * 30$)

So for full display for 10 rows we will need 19.2 ms

Refresh rate of 52 hz



Box



Current Draw

If light is white we need 60mA per segment.

Maximum current of 0.6 Amps per Line.

We need 6 Amps for 10 Lines.

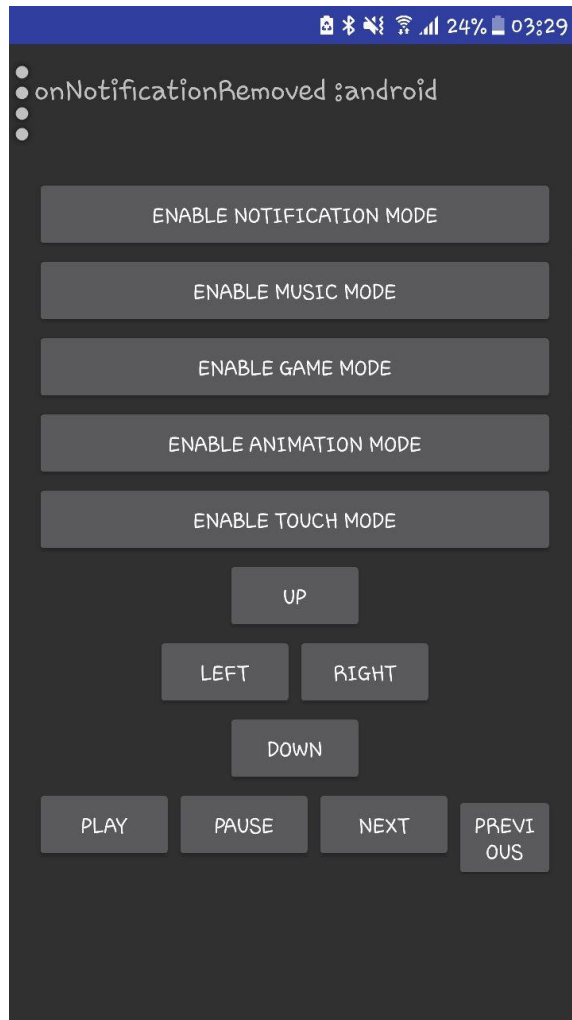
Our Control circuit withstands 10 Amp.

Power Supply 4.5 Amp



Applications

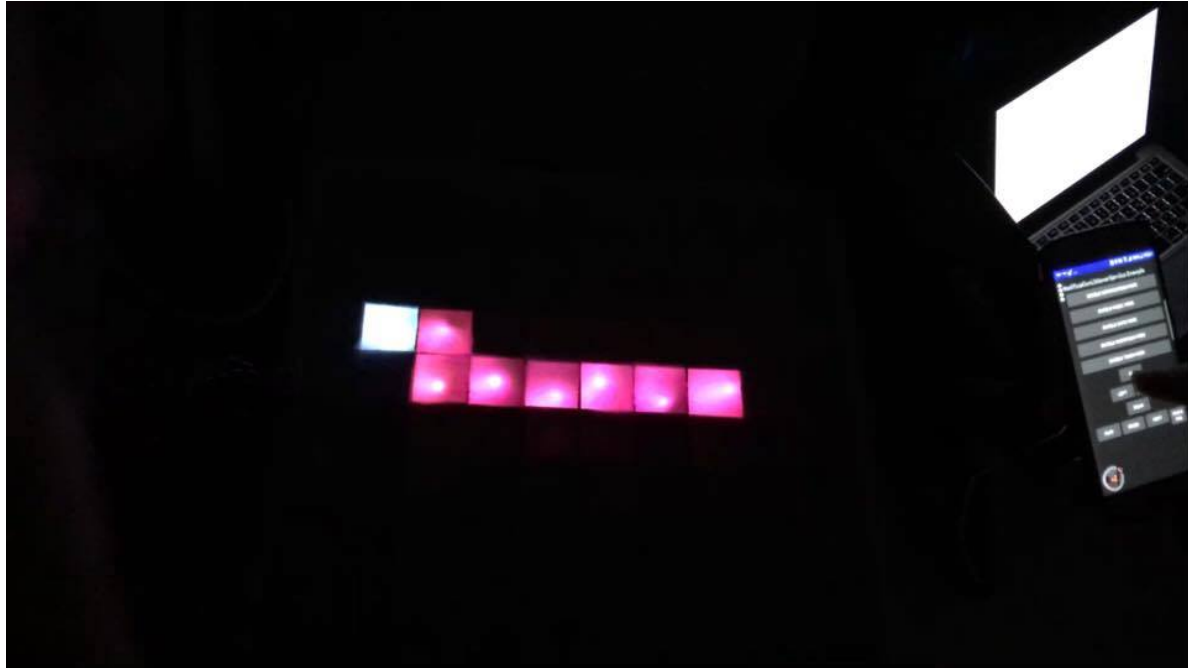
Mobile App



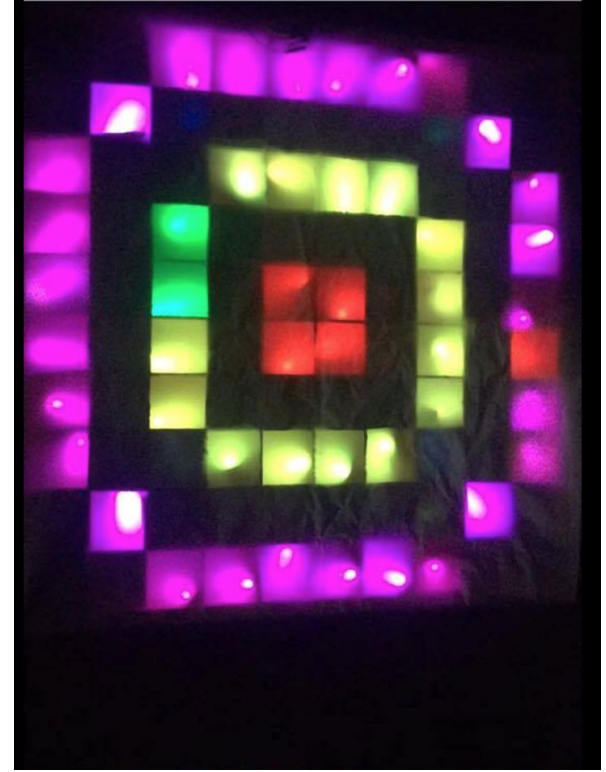
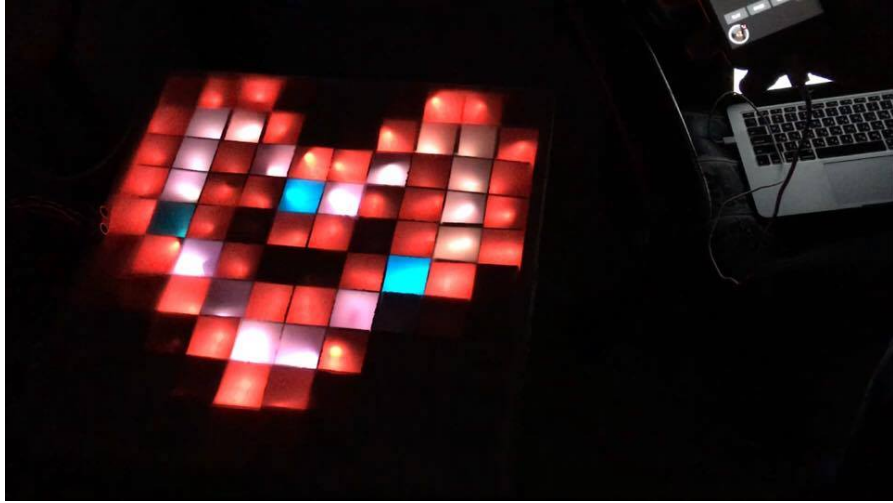
Notifications



Snake



Animations



Music Player

Touch

Demo